Heriot-Watt University
Research Gateway

Using Structural Equation Modelling (SEM) to Understand the Relationships among Critical Success Factors (CSFs) for Stakeholder Management in Construction

Citation for published version:
Molwus, JJ, Erdogan, B & Ogunlana, SO 2017, 'Using Structural Equation Modelling (SEM) to Understand the Relationships among Critical Success Factors (CSFs) for Stakeholder Management in Construction', *Engineering Construction and Architectural Management*, vol. 24, no. 3, pp. 426-450. https://doi.org/10.1108/ECAM-10-2015-0161

Digital Object Identifier (DOI):
10.1108/ECAM-10-2015-0161

Link:
Link to publication record in Heriot-Watt Research Portal

Document Version:
Peer reviewed version

Published In:
Engineering Construction and Architectural Management

General rights
Copyright for the publications made accessible via Heriot-Watt Research Portal is retained by the author(s) and / or other copyright owners and it is a condition of accessing these publications that users recognise and abide by the legal requirements associated with these rights.

Take down policy
Heriot-Watt University has made every reasonable effort to ensure that the content in Heriot-Watt Research Portal complies with UK legislation. If you believe that the public display of this file breaches copyright please contact open.access@hw.ac.uk providing details, and we will remove access to the work immediately and investigate your claim.

Download date: 05. May. 2023

Using Structural Equation Modelling (SEM) to Understand the Relationships among Critical Success Factors (CSFs) for Stakeholder Management in Construction

Journal:	*Engineering, Construction and Architectural Management*
Manuscript ID	ECAM-10-2015-0161.R3
Manuscript Type:	Original Article
Keywords:	Construction, Critical success factors, stakeholder management, Structural Equations Modelling, Project sucess, Relationships
Abstract:	

For Peer Review

SCHOLARONE™ Manuscripts

Using Structural Equation Modelling (SEM) to Understand the Relationships among Critical Success Factors (CSFs) for Stakeholder Management in Construction

ABSTRACT

Purpose – Stakeholder management plays a significant role in the successful delivery of construction projects. However, being able to carry out effective stakeholder management in construction is contingent upon understanding the interrelationships among the critical success factors (CSFs) for stakeholder management in construction and how they are related to project success. This would enable the persons responsible for stakeholder management to know the logical process for addressing the critical success factors in order to get stakeholder management right. The understanding of this relationship has not been addressed. This research aimed to investigate the interrelationships between the CSFs for stakeholder management and project success in construction.

Design/Methodology/Approach – From an extensive literature review, 23 critical success factors for stakeholder management in construction were identified. A conceptual structural equation model (SEM) of the relationships between critical success factors was developed (including measurement and structural models) using the groupings of the critical success factors for stakeholder management in construction. A questionnaire survey was used to collect data from construction industry practitioners. The data so collected were analysed using SEM in Analysis of Moment Structures (AMOS).

Findings – The SEM analysis of data collected resulted in the best fitting measurement model comprising 16 critical success factors as indicators of four latent variables namely, stakeholder characteristics and project characteristics; stakeholder analysis; stakeholder dynamics; and stakeholder engagement/empowerment. Furthermore, it was found that only stakeholder engagement/empowerment has direct positive impact on project success. The

For Peer Review

other three constructs stakeholder characteristics and project characteristics, stakeholder analysis and understanding stakeholder dynamism collectively impact on project success through the construct, stakeholder engagement/empowerment.

Research Limitations/Implications – The research reported in this paper was carried out in the UK hence the findings may have portrayed the UK construction professionals' opinion. However, the theoretical principles on which the research was based are general and similar research could be replicated in different countries whose construction procurement processes and industries are structured like those of the UK or otherwise.

Originality/Value – ~~The paper contributes to theory by empirically identifying the interrelationships among the critical success factors for stakeholder management linking to project success which will serve as a guide to construction professionals.~~The main contribution of this study to existing knowledge is an empirical evidence of the interrelationships among the CSFs for stakeholder management in construction through their latent variables which is portrayed in the best fitting structural model showing the relationships between the constructs of CSFs for stakeholder management and project success. This should serve as a guide to construction project management team or responsible professionals for undertaking stakeholder management in construction projects.

Keywords – construction, stakeholder management, Critical success factors, Project success, Relationship, structural equation modelling

Paper type – Research paper

INTRODUCTION

Despite continuous efforts aimed at improving project success in the construction industry, it has seldom been a common occurrence for construction projects to be

For Peer Review

successfully delivered. Construction projects are generally unique in nature due to their processes and interaction with numerous parties within and around them. Construction projects are traditionally divided into a series of activities undertaken by different individuals or groups who may have different levels of interest and or involvement in the project (Egan, 1998). Just like any other venture, they are constrained by time and resources which are needed for the projects to be delivered successfully (Ibrahim and Nissen, 2003; Bourne, 2005). The lengthy process of design and execution of construction projects constitutes a complex system which involves interactions, collaboration and negotiations among many stakeholders which include but are not limited to the clients, designers, contractors, local authorities and the general project environment (Cheeks, 2003; Winch 2010). Some individuals or groups (such as labour unions, employers' association, general public, the media, and institutional forces/nationalised industries (professional bodies) etc) may not be directly involved in the project but may have interest in and could have the power and be capable of influencing the project delivery process (Leung and Olomolaiye, 2010). All parties involved directly or indirectly in the project are referred as the project stakeholders. Satisfying the dynamic expectations of project stakeholders throughout the life cycle of the project is instrumental to the successful completion of construction projects (Atkin and Skitmore, 2008). This can be achieved through stakeholder management. Stakeholder management on projects should be carried out in order to obtain the support and contributions of stakeholders as much as possible towards the project and achieve the best possible results and project success (Black, 1995; Akintoye *et al*. 2003; Bourne, 2005; Olander and Landin, 2008; Jepsen and Eskerod, 2009). In the UK, client and stakeholder satisfaction is considered as one of the main performance indicators of construction projects and construction projects are now expected to be delivered to meet social value, sustainability and consideration of all stakeholders' interests and needs (Winch, 2010).

For Peer Review

The origin of stakeholder management theory has been attributed to Freeman's (1984) book – "*Strategic Management: A Stakeholder Approach*". Stakeholder management is concerned with the interrelationships between organisations and their diverse stakeholders which can impact the project as well as~~,~~ individual parties and organisations associated with the project both positively and negatively. Hence the aim of stakeholder management is for organisations to identify, analyse, understand and effectively manage their stakeholders (Chinyio and Olomolaiye, 2010). Although it started as a business management concept, the theory of stakeholder management has been increasingly applied across different fields including construction management. However, due to the peculiarity of construction projects and process, it is necessary to device construction specific stakeholder management principles.

Previous research efforts have investigated how stakeholder management in construction projects can be improved focusing on different aspects of stakeholder management in construction projects (Bourne and Walker, 2005; Chinyio and Akintoye, 2008). Most recently, Yang *et al*. (2009) and Yang and Shen (2014) developed a framework for successful stakeholder management in construction projects based on the exploratory groupings of the CSFs for stakeholder management. However, the exploratory groupings of CSFs in Yang et al.'s, framework did not measure the interrelationships among the constructs, the knowledge of which is needed to inform a logical stakeholder management process in construction projects. Factor analysis is used to reduce a large number of related variables into a manageable number of factors but to understand the interrelationships among the factors, other more advanced multivariate analyses techniques need to be used as factor analyses is not able to do so (Pallant, 2007). Furthermore, among the CSFs used in Yang et al.'s framework, CSFs such as the use of appropriate procurement routes and adoption of flexible project organisation were not considered. Therefore, there is need to empirically

For Peer Review

investigate the interrelationships among the CSFs for stakeholder management in construction. Moreover, how the CSFs for stakeholder management in construction projects are related to project success is yet to be understood. Understanding these will enable project management team to effectively carry out stakeholder management and achieve project success. But what is project success?

The primary aim of carrying out stakeholder management in construction projects is to deliver projects successfully. However, the perception of project success may not be that straight forward. The word success can mean different things to different individuals and to the same people in different circumstances or at different times (Bryde and Brown 2005; Toor and Ogunlana 2008). The traditional perception of project success being judged based on cost quality and time has changed over time to include stakeholder satisfaction, reduced conflicts and disputes and environmental friendliness (Lim and Mohamed, 1999; Cookie-Davies, 2002; Takim and Akintoye, 2002; Bryde and Brown 2005; Jugdev and Muller, 2005; Toor and Ogunlana 2010). It now requires that KPIs are set and achieved through the project in order for success to be attained (Chan and Chan 2004; Glenigan, 2011). Project success (PS) factors therefore, encompass achieving the key success indicators of the project which include: Timely completion of projects (PS1); on budget completion of projects (PS2); completion to specified quality (PS3); and completion to stakeholders' satisfaction (PS4) (Long *et al*., 2004; Chan *et al*., 2004; Jugdev and Muller, 2005).

For Peer Review

The ~~level and effectiveness~~undertaking of stakeholder involvement at the inception of the project and how it is sustained through the project life cycle has a big role in achieving the KPI's of projects. An effective stakeholder management process depends on the understanding of the CSFs for stakeholder management in construction projects (Yang *et al*., 2009) as this will enable the project management team to ~~effectively~~ successfully carry out stakeholder management and achieve project success. Therefore, the research questions to be answered in this study are: 1) How are the CSFs for stakeholder management in construction projects interrelated? and 2) How are the CSFs for stakeholder management in construction projects related to project success.

The research presented in this paper focussed on investigating the interrelationships among the CSFs and aims to conceptualise and empirically test the measurement and structural models of CSFs for stakeholder management in construction and how they are related to project success. While, the measurement model is a representation of the relationships between the CSFs and their constructs as well as the correlations/co-variations among the constructs; the structural model is a representation of the causal interrelations among the constructs of CSFs for stakeholder management in construction projects and how they are related to project success. This paper presents reviews of CSFs for stakeholder management in construction, the conceptual models (including measurement and structural models) of CSFs for stakeholder management in construction, and presents the methodology of the research, results and discussion before drawing conclusions.

CRITICAL SUCCESS FACTORS (CSFS) FOR STAKEHOLDER MANAGEMENT IN CONSTRUCTION

For effective stakeholder management in construction projects, it is necessary to identify and understand the interrelationships among the CSFs for stakeholder management. Therefore, CSFs should be given constant and careful attention in stakeholder management in construction being enablers of the process Critical success factors according to Rockart, (1979) are "*areas, in which results, if they are satisfactory, will ensure successful competitive performance for the organisation; they are the few key areas where things must go right for the business to flourish*". In other words, CSFs are actions, decisions, conditions or circumstances in which the right things have to be done in order for the desired goals to be

For Peer Review

achieved in a project. A very important step for the study reported in this paper is the identification of CSFs for stakeholder management in construction as they constitute the measured attributes (indicators for the measurement model). . Past studies (Jepsen and Eskerod, 2009; Olander and Landin, 2008; Chiyio and Akintoye, 2008; Jerges *et al*., 2000) have focused on identification of the factors which are critical to the success of stakeholder management in construction projects. For example Olander and Landin, (2008) identified four factors affecting stakeholder management process: Analysis of stakeholders' concern and needs; communication of both potential benefits and negative impacts to stakeholders; evaluation of alternative solutions; project organisation and relationship with the media. Similarly, (Jerges *et al*., 2000) suggested effective communication with stakeholders and setting common goals and priorities among them for the project will improve stakeholder management. Providing top level management support; responding to power interest dynamism; maintaining existing relationship; being proactive with decisions; negotiations and tradeoffs among others were considered necessary for successful stakeholder management/engagement in construction projects (Chinyio and Akintoye, 2008). Furthermore, Jepsen and Eskerod, (2009) found; stakeholder identification and classification as well as predicting the expectations of stakeholders through stakeholder analysis to be critical to stakeholder management process. The extensive literature review resulted in 23 critical success factors for stakeholder management in construction projects, which are presented in Table 1 including the specific actions and decisions. These are all encompassing factors which can vary from project to project and as the project progresses as a result of which some CSFs may be omitted during some projects. Deciding which CSFs to omit, will depend on project's organisation and mission among other things. These CSFs for stakeholder management in construction were used to develop the conceptual model used in this study based on the groupings by Molwus, *et al*. (2013) with slight modifications.

For Peer Review

<Table 1>

CONCEPTUAL MEASUREMENT AND STRUCTURAL MODELS OF CRITICAL SUCCESS FACTORS FOR STAKEHOLDER MANAGEMENT IN CONSTRUCTION

Identifying the critical success factors for stakeholder management in construction and grouping them are good initial steps towards successful stakeholder management in construction projects (Yang *et al*., 2009). However, in order to further equip industry practitioners and ensure successful stakeholder management, the relationships between these success factors and their groupings should be clearly understood. This section presents a conceptual (theoretical) model of the interrelationships among the CSFs for stakeholder management in construction and their latent variables (constructs) drawn from the extant literature. The following underlying principles were used for development of the conceptual model:

1. Obtaining detailed information about the projects and its stakeholders is considered the first major step of stakeholder management which in turn informs stakeholder analysis (Chinyio and Akintoye, 2008; Yang *et al*., 2009).
2. It is assumed being able to obtain such information entails knowing the characteristics of the project and its stakeholders.
3. The outcome of an informed stakeholder analysis/estimation would lead to the understanding of possible stakeholder dynamism and prediction of their likely behaviours on the basis of which appropriate stakeholder management/engagement strategies can be decided (Jepsen and Eskerod, 2009).

The measurement model consists of four constructs which were obtained by grouping the CSFs for stakeholder management grouped based on their related actions and the

For Peer Review

stakeholder issues they aim to address (Molwus, *et al*., 2013): Stakeholder characteristics and project characteristics (SCPC); Stakeholder analysis (SA); Stakeholder dynamics (SD); Stakeholder engagement/ empowerment (SE). The four constructs are individually and collectively considered as enablers of stakeholder management and are measured by the CSFs for stakeholder management in construction projects as shown in Table 2. The measurement model proposes a positive correlation between the four constructs and direct positive measurement of each construct by their indicators (Figure 1). The constructs and the hypothesized relationships in the structural model are explained in the following subsections.

Stakeholder Characteristics and Project Characteristics (SCPC)

Clear understanding of projects' and stakeholders' characteristics would avail the project management team sufficient information concerning the project and its stakeholders. Project characteristics include size, location, type of client, funding source, procurement issues, and objectives of the projects. Project characteristics as well as its potential impact should be clearly identified and documented at the early stages of the project in order to inform adequate stakeholder identification and analysis (Olander and Landin, 2005; Aaltonen *et al*., 2008; Jepsen and Eskerod, 2009). Stakeholder characteristics refer to stakeholders' stakes and interests, bases of involvement (direct or indirect), sources of power and other attributes (Mitchell, *et al*., 1997; Winch, 2010). Without such information, it would be very difficult to proceed with stakeholder management (Mitchell *et al*., 1997; Bourne and Walker, 2005). Therefore, the conceptual measurement model hypothesised that stakeholder characteristics and project characteristics is dependent upon the project management team's ability to clearly formulate the project mission; adopt a favourable procurement route for the project; carefully identify and list the project stakeholders; ensure the use of flexible project organisation; and identifying and understanding stakeholder areas of interest.

Under this construct, the following hypotheses are stated:

For Peer Review

Hypothesis 1: Obtaining adequate information on stakeholder characteristics and project characteristics (SCPC) influences the impact of stakeholder management on construction project success (PS).

Hypothesis 2: Obtaining adequate information on stakeholder characteristics and project characteristics (SCPC) enables stakeholder analysis (SA).

Hypothesis 3: Obtaining adequate information on stakeholder characteristics and project characteristics (SCPC) enables the understanding of stakeholder dynamism (SD).

Stakeholder Analysis (SA)

Stakeholder analysis consists of systematically determining stakeholders' areas and levels of interests; expected contributions; expected levels of power and influence; and level of importance; with respect to the project (Karlsen, 2002; Jepsen and Eskerod, 2009). It is important for project managers or responsible professionals to analyse the powers, needs and concerns of all project stakeholders, both internal and external to the project. If the needs and concerns of project stakeholders are not carefully analysed and addressed, conflicts and confrontations can arise among the stakeholders or between the stakeholders and the project and consequently hamper the successful delivery of the project (Aaltonen *et al*., 2008; Olander and Landin, 2008; Li *et al*., 2012). The results of stakeholder analysis will inform and shape decisions on stakeholder management for the project hence will enhance the likelihood of achieving success (Jepsen and Eskerod, 2009; Yang, 2014). Therefore, this construct (latent variable) is hypothesised to be indicated by the project management's ability to determine and assess stakeholders' attributes; appropriately classifying stakeholders according to their attributes; predicting and mapping stakeholders' behaviours; predicting stakeholders' potential influence on each other and on the project; and identifying and analysing possible conflicts and coalition among stakeholders.

For Peer Review

Under this construct, the following hypotheses are stated:

Hypothesis 4: Stakeholder analysis (SA) influences the overall impact of stakeholder management on construction project success (PS).

Hypothesis 5: Stakeholder analysis (SA) enables effective stakeholder engagement/empowerment (SE).

Stakeholder Dynamics (SD)

The stakes and interests of construction stakeholders can be as diverse as the stakeholders themselves and these are dynamic over the life cycle of projects (Chinyio and Akintoye, 2008). For example the primary interest of local residents is how the project affects their amenity and immediate environment; local land owners are interested in making sure that their interest will not be hurt by the project; the environmentalists are interested in protecting the environment from pollution and or destruction; the competitors try to gain competitive advantage by their actions; the media influence the perception of people about the reputation of the project; and others include those whose connection to the project is not immediately clear but whose support may be helpful to the success of the project (Leung and Olomolaiye, 2010). These interests can change as the project progresses because stakeholders' ability to influence and control project decisions and actions depend on their level of power and other associated attributes in the project. ~~These~~ Furthermore, stakeholder interests can change from stage to stage and even from time to time within the same stage during the projects' life cycle (Nash *et al*., 2010). Unless appropriate strategies are adopted for engaging and managing stakeholders based on their prevailing stance throughout the project's life cycle, they can spring up with surprises and hinder the progress of the project (Olander and Landin, 2005). In order to adopt the appropriate strategy for engaging stakeholders, it is necessary to understand the changing (dynamic) nature of stakeholders'

For Peer Review

attributes during the project. It should be noted that understanding stakeholders' dynamism depends largely on careful stakeholder analysis (Aaltonen *et al*., 2008). Therefore, this construct is indicated by project management's ability to effectively resolve conflicts among stakeholders; manage change of stakeholders' interest and influence; manage change of stakeholders' attributes; manage change of relationships among stakeholders; predict stakeholders' likely reaction for implementing project decisions and manage how project decisions affect stakeholders.

Under this construct, the following hypotheses are stated:

Hypothesis 6: Understanding stakeholder dynamism (SD) influences the overall impact of stakeholder management on construction project success (PS).

Hypothesis 7: Stakeholder analysis (SA) enables the understanding of stakeholder dynamism (SD).

Hypothesis 8: Understanding stakeholder dynamism (SD) enables effective stakeholder engagement/empowerment (SE).

Stakeholder Engagement/Empowerment (SE)

Given their dynamic nature and lengthy process of construction, stakeholders adopt different strategies at different stages of project to exert their interests on the project (Aaltonen *et al*., 2008), hence different appropriate strategies should be used for engaging/managing stakeholders at different stages of the project depending on the prevailing circumstances. Using the most appropriate strategies for engaging project stakeholders will enable project success to be achieved (Chinyio and Akintoye, 2008). For instance, while some stakeholders can be communicated to using letters/flyers about project decision others must be contacted directly through meetings/workshops or project website to get their inputs

For Peer Review

about the project depending on their classification in the project. Therefore, this construct is indicated by the project management's ability to involve relevant stakeholders in refining project mission whenever necessary; formulate appropriate strategies to manage/engage different stakeholders; keep and promote positive relationships among the stakeholders; communicating with stakeholders properly and frequently with feedback mechanisms; and considering all social responsibility issues surrounding the project.

Under this construct, the following hypotheses are stated:

Hypothesis 9: Effective stakeholder engagement/empowerment (SE) influences the impact of stakeholder management on construction project success (PS).

Hypothesis 10: Obtaining adequate information on stakeholder characteristics and project characteristics (SCPC) enables effective stakeholder engagement/empowerment (SE).

<Table 2>

<Figure 1>

Based on the hypotheses stated under the four constructs of CSFs for stakeholder management in construction projects, adequately obtaining information on stakeholder characteristics and project characteristics (SCPC); carrying out informed stakeholder analysis (SA); understanding stakeholder dynamics (SD); and effective stakeholder engagement/empowerment (SE),, a structural model is developed (portrayed in Figure 2) to further investigate the interrelationships among the critical success factors for stakeholder management in construction and how they relate to project success:

<Figure 2>

For Peer Review

RESEARCH METHODS ADOPTED TO TEST THE CONCEPTUAL MEASUREMENT AND STRUCTURAL MODELS

Data collection and screening

A quantitative approach was adopted to empirically test the conceptual model of the interrelations among CSFs for stakeholder management in construction. A questionnaire was designed to investigate 23 CSFs grouped under four latent variables (constructs) to elicit responses from construction professionals within United Kingdom. Professionals in architecture, construction management, quantity surveying, engineering, facility management, including clients' representatives and designers etc with at least five years of relevant professional experience working on large construction projects with multiple stakeholder issues were targeted to participate in the survey. The survey respondents were asked to rate their agreement with the CSFs as indicators of stakeholder management decisions/actions and their influence on stakeholder management and project success based on a five point Likert scale in which 1 = strongly disagree and 5 = strongly agree. The questionnaire also gathered background information of the respondents in order to ensure that they have the required background and years of professional experience to take part in this survey before their responses are used for analyses. A minimum of 5 years relevant professional experience was set for the respondents to ensure they have participated in some projects up to completion so that they can have practical knowledge of stakeholder management issues.

Stratified random sampling was used to select respondents from construction professionals practicing in the UK the entire population of which could not be ascertained. The respondents were selected through the website/company profiles of construction organisations delivering construction services. According to Saunders, et al. (2009) if the size of population is not known the following formula can be used to determine the sample size

For Peer Review

for survey research: Sample size = [(minimum sample size required × 100) ÷ Average percentage response rate expected]. For the purpose of ~~sampling~~analysis, a minimum of 50 responses was required to achieve the objectives of the current study (Iacobucci, 2010). Using an estimated response rate of 25% based on the average response rate obtainable in similar research in construction management, the sample ~~population~~ size for the current study was determined as follows: [(50 × 100) ÷ 25] = 200 (Saunders, et al. 2009). The survey link was therefore sent to 200 professionals practicing within the United Kingdom. After two reminders (at one month's interval each) a total of 74 responses were received representing 37% of the total number of respondents to whom the link to the survey was emailed. Out of the 74 responses received, 13 were rejected for having less than 5 years of professional experience in construction and/or for incomplete responses. 61 responses (30.5% of respondents contacted) were found suitable and accepted for analysis;

Data Analysis

Several statistical tools have been considered when selecting the appropriate analysis tool for the current study. To examine the groupings of the critical success factors for stakeholder management in construction, confirmatory factor analysis (also known as the measurement component of SEM) can be used. Whereas, to investigate the interrelationships among the CSFs through their constructs; different forms of regression analysis can be used in a step by step fashion. However, the hypothesised models in the current study require the interrelationships to be explored simultaneously in a holistic manner so that errors of measurement can be adequately taken into account. To achieve this objective, structural equation modelling (SEM) was considered the most appropriate. SEM was chosen over other multivariate statistical analysis methods due to its ability for the simultaneous examination of relationships among a number of dependent (latent) and independent (observed) variables (Hair *et al.*, 1998). Another reason for choosing SEM was its ability to take into account the

For Peer Review

measurement errors inherent in subjective operational measurement and to define and explain the entire set of relationships in the hypothesised model (Byrne, 2010).

The development of SEM usually goes through some basic stages (Hair *et al.*, 1998) which include:

1. Identify and define (operationally) the model components (which include latent variables, measured variables and any other variables) based on theory.
2. Set up a hypothetical model (model specification) which sometimes may involve setting up more than one model (competing models) depending on the theoretical bases and aim of the research;
3. Assess the validity of the model using data collected based on the operationalised components (variables) of the model by evaluating model estimates and goodness of fit indices; and
4. Identify potential model changes and modify the model with theoretical justification.

The first two stages were achieved using literature review to identify the model components and set up hypothetical models (including measurement and structural models) and the last two stages were achieved during the data analysis stages of the study presented in this paper. In this study, no alternative models were developed as the aim was to investigate the interrelationships among CSF for stakeholder management in construction and how they are related to project success rather than comparing candidate theories and choose from. Competing models are used only when there are well established alternative/competing theories to be tested in the study (Kline, 2005). The conceptual structural model in this study includes all possible hypotheses on the relationships between the constructs and tests the validity of each hypothesis on a single model.

For Peer Review

SEM analysis comprise of two components; the measurement component and the structural components. While the measurement component enables analysis of relationships between the latent variables (constructs) and their indicators (observed variables); the structural component is used to analyse interrelationships among the latent variables. The measurement model also takes into account the measurement errors associated with the indicators which are measured operationally.

There is no consensus on the acceptable thresholds for sample sizes among researchers that used SEM. One group of researchers recommend large sample sizes (from 100 to 400) whereas construction management researchers (for example; Doloi *et al*., 2012; Doloi, 2009; Erikson and Pesamaa, 2007; Ozorhon *et al*., 2007; Islam and Faniran, 2005, Mohammed, 2000) have used smaller sample sizes, giving different reasons for doing so. The 61 responses in the current study having been collected from well experienced respondents with relevant professional backgrounds working on large projects with demanding stakeholder issues to whom the research objectives were clearly explained are considered reliable. Furthermore, the spread across construction professionals among the respondents, adds to the reliability of the data for investigating critical success factors for stakeholder management in construction. Table 3 presents the respondents' profiles in terms of their years of professional experience and professional field of practice with all of them, having relevant experience of at least 5 years and over 78% of them having 10 years and above experience. Moreover, all the targeted respondents are known to have worked on projects with multi parties and had to collaborate or engage with all or most of the parties. It was ensured during sampling that the respondents with the professional fields of architecture, construction management and engineering; include clients' representatives and designers. Given the inherent difficulty to collect questionnaire data in construction management research and coupled with the characteristics sought in the targeted respondents which limit the number of

For Peer Review

eligible respondents, 61 is a good sample size for this study. If the model to be tested using SEM is not overly complex and source of data is very reliable, sample size of 50 can be enough (Iacobucci, 2009).

<Table 3>

Preliminary Analysis for Consistency Checks

Preliminary (consistency) analyses including mean ratings of the CSFs, un-rotated principal component factor analysis and standardised Cronbach's alpha coefficient were performed using IBM SPSS 20. The mean ratings of the CSFs were obtained to check for acceptance of the CSFs by the respondents; un-rotated principal component factor analysis was performed to check for commonality within the data set; and standardised Cronbach's alpha coefficient was used to check for reliability of measurement within the data set. Finally, structural equation modelling with IBM AMOS 20 software was used to test the hypothesised measurement model of the interrelations among the CSFs and their latent variables. The results are presented in the subsequent sections.

For Peer Review

ACCEPTANCE, COMMONALITY AND RELIABILITY TESTS RESULTS

It was necessary to carry out consistency tests to make sure that there are no issues of consistency associated with the data set. These tests include the mean ratings and ranking of all CSFs by the survey respondents to ascertain the acceptance of the CSFs by the respondents; un-rotated principal component analysis to check for commonality; and Cronbach's alpha coefficient test to check for reliability of the measured variables scale (Hair *et al*., 2008). All of these tests were done using IBM SPSS 20 software.

The result of mean rating presented in Table 4 reveals high level of agreement that the CSFs are important for stakeholder management in construction projects. The factor with the highest rating by all respondents is “involving relevant project stakeholders at the inception stage and whenever necessary to refine project mission” (SE1) with mean rating of 4.43 and the factor with the lowest rating is “ensuring the use of flexible project organisation” (SCPC4) with mean rating of 3.85.

The result of un-rotated principal component analysis revealed the existence of more than one factor (up to 6 possible factors) as shown in Appendix A, indicating that commonality is not an issue within the data. If the results of un-rotated principal component factor analysis reveal the existence of only one factor, then it suggests that commonality is an issue meaning the factors in the data set are likely to fall into the same group (Schriesheim, 1979).

Standardised Cronbach’s alpha coefficient of 0.907 was obtained for the measured variables indicating high reliability. Cronbach’s alpha values should be at least 0.70 with values closer to 1.0, indicating better reliability (Nunnally and Bernstein, 1994; Hair *et al*., 2008). Having confirmed the acceptance of all the CSFs, absence of commonality and reliability, the measurement model was then tested.

<Table 4>

RESULTS OF MEASUREMENT MODEL OF CSFS FOR STAKEHOLDER MANAGEMENT IN CONSTRUCTION

IBM SPSS AMOS 20 software was used to empirically test the hypothetical model of critical success factors (CSFs) for stakeholder management in construction. To achieve this, the measurement model component of structural equation modelling (SEM) was used to investigate the appropriateness and strength of the relationships between the observed and

For Peer Review

latent variables as well as to measure if there are any, correlations/co-variances among the four latent variables.

Using confirmatory factor analysis (CFA) also known as “measurement model”, the assessment of fit between the data collected and the theoretically conceptual model (Figure 1) of the relationships between observed and latent variables was done. It is important to note that the latent variables in the hypothetical model include: stakeholder characteristics and project characteristics (SCPC); stakeholder analysis (SA); stakeholder dynamics (SD); and stakeholder engagement/empowerment (SE); and their indicators (measured variables) are the CSFs presented in Table 1.

SEM uses goodness-of-fit (GOF) indices shown in Table 5 from the output obtained in AMOS in order to assess how well the hypothesised model fits the data set. The GOF indices used in this study include the root mean square residual (RMR), comparative fit index (CFI), incremental fit index (IFI), Tucker-Lewis index (TLI), goodness of fit index (GFI), ratio of minimum discrepancy to the degrees of freedom (CMIN/DF) and root mean square error of approximation (Anderson and Gerbing, 1984; Kline, 2004; Iacobucci, 2010). The RMR computes the residual differences between the data set and model prediction and take the square root of the result. It ranges from 0 – 1 with smaller values indicating better fit. The CFI compares the fit of a baseline model to the data with the fit of the hypothesised model to then same data. It also ranges from 0 – 1 but with larger values indicating better fit. IFI is the ratio of the difference between the discrepancy and degrees of freedom of the hypothesised model and that of the baseline model. It also ranges from 0 – 1 with larger values showing better fit. The TLI compares the discrepancy and degrees of freedom for the hypothesised model with those of the baseline model. It also ranges from 0 – 1 with larger values indicating better fit. The GFI is a test if the maximum likelihood estimate of the hypothesised model fit to the data set. It also ranges from 0 – 1 and higher values indicate better fit. The

For Peer Review

CMIN/DF adjusts the chi-square by computing the ration of the minimum discrepancy to degrees of freedom. It ranges from 1- 2 with vales closer to 1 indicating closer fit.

After analysing the hypothesised measurement model, the path coefficients and the GOF indices revealed the need to refine/modify the measurement model. Three main considerations are used to modify models in SEM (Kline, 2005). These include: looking for and eliminating paths with very low factor loadings; removing variables indicated by the modification indices as having multi-co-linearity; and removing observed variables with very high values in the standardised residual correlation matrix. Additionally, model refinement/modification should lead to the selection of a fitting model which satisfies not only the GOF measures but also falls within and satisfies the theoretical expectation (Molenaar, *et al*., 2000; Byrne, 2010). After going through the refinement/modification steps, seven observed variables were dropped from the hypothesised measurement model for showing signs of multi-co-linearity and having many high standardised residual correlations above 0.4: three from SCPC (SCPC1, SCPC4, and SCPC5); three from SD (SD1, SD6, and SD7) and one from SE (SE4). Furthermore, three observed variables (SA1, SA2, and SE1) have been relocated to another construct and all the correlations among the latent variables were retained (see Table 6). Since the CSFs excluded from the measurement model have been strongly accepted by the respondents based on their mean ratings presented in Table 4; they have been compared with and realigned into other factors that have been retained in the final measurement model. The reason is to avoid losing too much of the CSFs and care was taken to ensure that the final CSFs constituting the measured variables in the best fitting model are still consistent with the extant theoretical postulations. This lead to the merging (realignment) of CSFs presented in Table 7 based on which the final measurement and structural models were analysed. The resultant best fitting measurement model is portrayed in Figure 3 as further refinement/modification failed to improve the model fit. The GOF indices

For Peer Review

for both the conceptual measurement model and the fitting measurement model are presented in Table 5.

<Table 5>

<Figure 3>

The strength with which the observed variables measure the latent variables in the best fit measurement model, is indicated by their standardised path coefficients (also known as factor loading). Table 6 shows the path coefficients of the influence of the observed variables on the latent variables. Since the standardised path coefficients range from 0.54 to 0.89, it is indicated that the retained observed variables significantly measure the latent variables. Moreover, all the path coefficients are positive and statistically significant at level $P < 0.05$, therefore, they are supported. Values of factor loading equal to or greater than 0.40 with significant P value <0.05 indicate strong measurement with values closer to 1 indicating stronger measurement (Li *et al*., 2005; Akson and Hadikusumo, 2008). This suggests that the latent variables are valid groupings of the CSFs for stakeholder management in construction projects.

<Table 6>

<Table 7>

Similarly, the strengths of the correlations and covariant relationships among the latent variables are shown in Table 8 indicating that the latent variables strongly affect one another positively with the smallest value of correlation being 0.579 (between SD and SE) which is still above the minimum threshold of 0.5. Furthermore, all the correlations are statistically significant at level $P < 0.05$ and the covariance estimates are all below the maximum threshold of 0.3. The standard errors (S.E.) do not present with any outliers (i.e.

For Peer Review

any extremely large or small values) same as the critical ratios (C.R.). Therefore, all the hypothesised correlations among the latent variables are supported and the specific interrelationships among them can be investigated in a structural component of SEM.

<Table 8>

RESULTS OF STRUCTURAL MODEL AND HYPOTHESES TESTING

Figure 4 presents the final structural equation model of CSFs for stakeholder management in construction projects with standardised path coefficients on the structural paths of the supported hypothesised relationships shown in Figure 2. The standardised path coefficients of the hypothesised relationships were tested using critical ratios, standard errors and their level of statistical significance to ascertain whether the hypotheses are supported by the data set or not (see Table 9).

<Figure 4>

As presented in Table 9, the standard errors (S.E.) do not present with any extremely high or low values except for that of H4. The critical ratios (C.R.) for H1, H3, H4 and H6 are extremely low and a further look at the results presented in Table 9 reveal that only four hy-pothesised relationships are supported at the statistical significance level of P<0.05. The rela-tionship path between stakeholder characteristics and project characteristics (SCPC) and stakeholder dynamism (SD) with insignificant P value of 0.322 and low path coefficient of 0.255 does not support Hypothesis 3. Similarly the paths between stakeholder analysis (SA) and project success (PS) with insignificant P value of 0.721 and a negative low path coeffi-cient of -0.125; stakeholder dynamism (SD) and project success (PS) with insignificant P value of 0.902 and a low path coefficient of 0.041; stakeholder characteristics and project characteristics (SCPC0 and project success (PS) with insignificant P value 0.968 and low

For Peer Review

path coefficient of 0.012 failed to support Hypotheses 4, 6, 1 respectively. Conversely, the relationship path between stakeholder characteristics and project characteristics (SCPC) and stakeholder analysis (SA) with P value of 0.002 and path coefficient of 0.772 strongly supports Hypothesis 2. Other hypotheses supported by the results presented in Table 9 include Hypotheses 7, 8 and 9. They are supported by the paths between stakeholder analysis (SA) and stakeholder dynamism (SD) with significant P value of 0.025 and acceptable path coefficient of 0.608; stakeholder dynamism (SD) and stakeholder engagement/empowerment (SE) with very significant P value and acceptable path coefficient of 0.634; and stakeholder engagement/empowerment (SE) and project (PS) with significant P value of 0.008 and acceptable path coefficient of 0.695; respectively. Table 10 presents the GOF measures for the conceptual and best fitting structural models of critical success factors for stakeholder management in construction. Figure 4 indicates improvement in the strengths of the supported hypothesis after deleting the hypotheses not supported as shown in Table 9.

<Table 9>

<Table 10>

DISCUSSION OF FINDINGS

This study investigated the interrelationships among the CSFs for stakeholder management in construction projects based on four latent variables drawn from previous research. The results indicate the existence of statistically significant relationships between the measured (CSFs) and latent variables and among the latent variables (SCPC, SA, SD and SE).

The findings based on the measurement model indicate that SCPC4 “Ensuring the use of flexible project organisation” has the least mean rating 3.85 which is still way above the

For Peer Review

acceptable rating for a five-point Likert scale being 3.5. This connotes that the survey respondents considered all the 23 CSFs as vital for the success of stakeholder management in construction which is partly in line with the findings of Yang *et al*., (2009) except for the additional CSFs. Furthermore, Yang *et al*. (2009) found that SE5 (Considering corporate social responsibilities (paying attention to Economic, legal, environmental, and ethical issues)) was the most important CSF and could not be grouped under any of the constructs and identified it as the precondition factor of stakeholder management in construction projects. However, the findings in the current study grouped SE5 under stakeholder engagement (SE) with a factor loading of 0.68. Additionally, the most important CSF in the current study is SE1 (Involving relevant project stakeholders at the inception stage and whenever necessary to refine project mission) which was initially hypothesised to be under the construct stakeholder engagement/empowerment (SE) but the result of the measurement model analysis moved it to the construct stakeholder characteristics and project characteristics (SCPC). As reported in the preceding section, the results of the "measurement model" excluded 7 CSFs from the best fitting measurement model including SCPC1, SCPC4, SCPC5, SD1, SD6, SD7 and SE4 which were deleted during model modification (please see Table 4 for their full meanings).

The strong correlation estimates presented in Table 8 pointed to the existence of some interrelationships direct or indirect among the constructs of CSFs for stakeholder management in construction (SCPC, SA, SD and SE). When the hypothesized relationships were tested, the final structural model suggested that only one of the constructs, stakeholder engagement/empowerment has a direct positive impact on project success. The results (See Figure 4 and Table 9) indicated that the other three constructs (SCPC, SA and SD) can not directly influence project success (PS) but they influence project success indirectly by their collective interactions through stakeholder engagement/empowerment (SE) as follows:

For Peer Review

- Stakeholder characteristics and project characteristics (SCPC) influence stakeholder analysis (SA) with a very high path coefficient of 0.81 and a significant P value of 0.026.
- Stakeholder analysis (SA) in turn influences the understanding of stakeholder dynamism (SD) with an equally high path coefficient of 0.83 and a significant P value of 0.002.
- The understanding of stakeholder dynamism (SD) will enable stakeholder engagement/empowerment (SE) with an acceptable path coefficient of 0.62 and a very significant p value.
- Stakeholder engagement/empowerment (SE) influences project success (PS) with an acceptable path coefficient of 0.65 and a very significant P value.

The finding that stakeholder analysis (SA) can not directly impact/influence project success (PS) is a shift from the view within the construction based stakeholder management literature that stakeholder analysis can lead to project success (Jepsen and Eskerod, 2009; Olander and Landin, 2005). However, stakeholder engagement/empowerment (SE) being the only construct found to directly influence project success (PS) depends on the understanding of stakeholder dynamism (SD) which also depends very strongly on the results of stakeholder analysis (SA). The finding that understanding stakeholder dynamism (SD) depends on the results of stakeholder analysis (SA) is in agreement with the position of Aaltonen *et al.* (2008). Moreover, the lack of support for the H3 (Obtaining adequate information on stakeholder characteristics and project characteristics – SCPC enables the understanding of stakeholder dynamism – SD) can be considered counter intuitive. Furthermore, the findings suggest that obtaining information on project characteristics and stakeholder characteristics (SCPC) is a major precondition step in the process of stakeholder management. This finding is in line with the opinion canvassed by a faction of the extant literature (Mitchell *et al.*,

For Peer Review

1997; Chinyio and Akintoye, 2008) and disagrees with the position of Yang *et al*. (2009) that the precondition factor for stakeholder management in construction projects is "considering corporate social responsibilities" which by the findings of the current study is an indicator of stakeholder engagement/empowerment (SE).

CONCLUSIONS

The aim of this study was to enhance the knowledge on stakeholder management in construction and improve the understanding of the critical success factors of stakeholder management and the interrelations among them. In order to achieve this aim, a conceptual measurement model was developed based on the analysis of literature review findings. The fit between the extant theoretical standing and the survey data was examined and after an iterative statistical process the final structural model for critical success factors of stakeholder management was developed and accepted.

Effects of stakeholder analysis, stakeholder characteristics and project characteristics, stakeholder engagement and stakeholder dynamics on the stakeholder management and on project success were investigated. The reliability of each construct and the overall model is highly satisfactory as all goodness of fit indices were very good.

The findings indicated that that all stakeholder management decisions made in the four distinct constructs (obtaining information on project characteristics and stakeholder characteristics; undertaking stakeholder analysis; understanding stakeholder dynamism; and stakeholder engagement/empowerment) affect each other directly or indirectly as follows:

For Peer Review

- The ability of the project management team to clearly obtain adequate information on stakeholder characteristics and project characteristics will influence and aid their ability to carry out stakeholder analysis.
- Understanding stakeholder dynamism depends on the results of stakeholder analysis.
- Decisions on how to effectively engage/empower stakeholders during construction projects relies on the good understanding of stakeholder dynamism.
- Effective stakeholder engagement/empowerment will facilitate project success

These relationships indicated that obtaining information about project characteristics and stakeholder characteristics (SCPC) is the precondition factor (construct) to be able to carry out effective stakeholder management in construction. Failure to adequately and holistically address the critical success factors for stakeholder management in construction projects will prevent stakeholder management efforts from achieving the desired results-project success.

The main contribution of this study to existing knowledge is an empirical evidence of the interrelationships among the CSFs for stakeholder management in construction through their latent variables which is portrayed in the best fitting structural model (Figure 4) showing the relationships between the constructs of CSFs for stakeholder management and project success. This should serve as a guide to construction project management team or responsible professionals for successfully undertaking stakeholder management in construction projects. From the result presented in Table 4, all the 23 CSFs for stakeholder Management in construction projects should be given adequate considerations. None the less, the five most important CSFs are:

1. SE1 – Involving relevant project stakeholders at the inception stage and whenever necessary to refine project mission;

Formatted: Font: Times New Roman, 12 pt

Formatted: List Paragraph, Numbered + Level: 1 + Numbering Style: 1, 2, 3, … + Start at: 1 + Alignment: Left + Aligned at: 0.75" + Indent at: 1"

For Peer Review

2. SCPC5 – Identifying and understanding stakeholders’ areas of interests in the project;
3. SE4 – Communication with stakeholders properly and frequently;
4. SD6 – Managing how project decisions affect stakeholders; and
5. SD1 – Resolving conflicts among stakeholders effectively.

Based on the findings portrayed in Figure 4 and highlighted in the conclusion, the first thing to do in order to be successful in stakeholder management, is to indentify Stakeholder Characteristics and Project Characteristics (SCPC) following which Stakeholder Analysis (SA) is performed the results of which will inform the project management team of the project’s Stakeholder Dynamism (SD) based on which appropriate Stakeholder Engagement/Empowerment techniques (SE) are Decided. Therefore, the practical steps for successful stakeholder management in construction project are to follow the following sequence: Indentify Stakeholder Characteristics and Project Characteristics (SCPC) – Carry out Stakeholder Analysis (SA) – Understand Stakeholder Dynamism (SD) – Decide Stakeholder Engagement/Empowerment techniques (SE). Likewise this should serve as a guide for further research on stakeholder management processes.

The main limitation of this study is that only the opinion of the key internal stakeholders was considered. Further research should therefore take into account the opinions of a wider range of stakeholders including external stakeholders. Furthermore, a larger sample size should be targeted in similar future studies. Moreover, ~~T~~the research reported in this paper was carried out in the UK as discussed earlier under the research methods section; hence the findings may have portrayed the UK construction professionals’ opinion. However, the theoretical principles on which the research was based are general and similar research could be replicated in different countries whose construction procurement processes and industries are structured like those of the UK or otherwise. Furthermore, the sequential steps

For Peer Review

of the process of stakeholder management portrayed in Figure 4 can be tested on real life projects.

REFERENCES

Aaltonen, K., Jaakko, K. And Tuomas, O. (2008). Stakeholder salience in global project, *International Journal of Project Management*, 26, 509-516.

Akintoye, A., Hardcastle, C., Beck, M., Chinyio, E., and Asenova, D. (2003). Achieving best value in private finance initiative project procurement, *Construction Management and Economics*, 21(5), 461 – 470.

Aksorn, T.; Hadikusumo, B. H. W. (2008). Critical success factors influencing safety program performance in Thai construction projects, *Safety Science* 46: 709–727. Doi:10.1016/j.ssci.2007.06.006

Atkin, B. and Skitmore, M. (2008) Editorial: Stakeholder management in construction, *Construction Management and Economics*, 26: 6, 549 – 552.

Black, K., (1995). Causes of project failure: a survey of professional engineers. *PM Network*, November; 21-24.

Bourne, L. (2005) Project relationship management and the stakeholder circle, Doctoral thesis, *Graduate School of Business, Melbourne*, RMIT University.

Bourne, L. and Walker, D.H.T. (2005). Visualising and mapping stakeholder influence. *Management Decision*, 43(5), 649–60.

Byrne, B. M. (2010). *Structural Equation Modelling with AMOS: Basic Concepts, Applications and Programming,* (2nd ed.), Routledge, Taylor and Francis Group, New York.

For Peer Review

Cheeks, J. R. (2003). Multistep disputes resolution in design and construction industry. *Journal of Professional Issues in Engineering Education and Practice*, ASCE, 129(2), 84-91.

Chinyio, E. A. and Akintoye, A. (2008). Practical approaches for engaging stakeholders: findings from the UK, *Construction Management and Economics*, 26: 6, 591-599.

Cleland, D.I., 1999. *Project Management Strategic Design and Implementation*. McGraw-Hill, New York.

Doloi, H., Sawhney, A. and Iyer, K. C. (2012a). Structural equation model for investigating factors affecting delay in Indian construction projects. *Construction Management and Economics*, DOI:10.1080/01446193.2012.717705, 1-16.

Egan, J., (1998). Rethinking construction: report of the construction task force on the scope for improving the quality and efficiency of UK construction, *Department of the Environment, Transport and the Region*, London.

Eriksson, P.E. and Pesamaa, O. (2007). Modelling procurement effects on cooperation. *Construction Management and Economics*, 25, 893–901.

Hair, J.F., Anderson, R.E., Tatham, R.L. and Black, W.C. (2008). *Multivariate Data Analysis*, (7th ed.). Prentice Hall Publisher, Upper Saddle River, New Jersey.

Ibrahim, R., Nissen, M., (2003). Emerging Technology to Model Dynamic Knowledge Creation and Flow among Construction Industry Stakeholders during the Critical Feasibility-Entitlements Phase. *Proceedings of The American Society of Civil Engineers (ASCE) 4th Joint Symposium on IT in Civil Engineering. ASCE, Nashville*, TN, pp. 1–14. Nov. 15-16.

Iacobucci, D. (2010). Structural equations modelling: Fit indices, sample size, and advanced topics. *Journal of Consumer Psychology*, 20, 90-98.

For Peer Review

Islam, M.D.M. and Faniran, O.O. (2005). Structural equation model of project planning effectiveness, *Construction Management and Economics*, 23, 215–23.

Jepsen, A. L. And Eskerod, P. (2009). Stakeholder analysis in projects: challenges in using current guidelines in the real world, *International Journal of Project Management* 27, 335 – 345.

Jergeas, G.E., Williamson, E., Skulmoski, G.J., Thomas, J.L., (2000). Stakeholder management on construction projects. *AACE International Transactions* 12, 1–5.

Karlsen, J. T. (2002). Project stakeholder management, *Engineering Management Journal*, 14: 4, 19-24.

Kline, R.B. (2005). *Principles and Practice of Structural Equation Modelling*: Methodology in the Social Sciences. *Guilford Press*, New York.

Leung, M. and Olomolaiye, P. (2010). Risk and construction stakeholder management. *In: Chinyio, E. and Olomolaiye, P. (Eds.) Construction Stakeholder Management*, John Wiley & Sons Ltd, United Kingdom, Pg 75 – 98.

Li, B.; Akintoye, A.; Edwards, P. J.; Hardcastle, C. (2005). Critical success factors for PPP/PFI projects in the UK construction industry, Construction Management and Economics 23: 459–471.

Li, T. H. Y., Ng, T. S. and Skitmore, M. (2012). Conflict or consensus: An investigation of stakeholder concerns during the participation process of major infrastructure and construction projects in Hong Kong, *Habitat International*, 36, 333 – 342.

Mathur, V. N., Price, A. D. F. And Austin, S. (2008). Conceptualizing stakeholder engagement in the context of sustainability and its assessment, *Construction Management and Economics*, 26: 6, 601-609.

For Peer Review

Mitchel, R. K., Agle, B. R. And Wood, D. J. (1997). Toward a theory of stakeholder identification and salience: defining the principle of who and what really counts, *Academy management review*, vol 22 no 4.

Molenaar, K., Washington, S. and Diekmann, J. (2000). Structural equation model of construction contract dispute potential. *J. Constr. Eng. Manage.*, 126 (4), 268–277.

Molwus, J. J., Erdogan, B., and Ogunlana, S. O. (2013). Critical success factors for stakeholder management and project success in construction projects. *11th International Post Graduate Research Conference (IPGRC)*, 8th –10th April, Media city, Manchester, University of Salford, 758 – 767.

Nash, S., Chinyio, E., Gameson, R. and Suresh, S. (2010). The dynamism of stakeholders' power in construction projects. *In: Egbu, C. (Ed) procs 26th Annual ARCOM conference*, 6 – 8 September, Leeds, UK, Association of Researchers in Construction Management, 471 – 480.

Nunnally, J.C. and Bernstein, I.H. (1994) Psychometric Theory, McGraw-Hill, New York.

Olander, S. and Landin, A. (2005). Evaluation of Stakeholder influence in the implementation of construction projects, *International Journal of Project Management*, 23, pp 321-328.

Olander, S. and Landin, A. (2008). A comparative studies of factors affecting the external stakeholder management process, *Construction Management and Economics*, 26(6), 553.doi:10.1080/01446190701821810

Pajunen, K. (2006). Stakeholder influences in organisational survival, *Journal of Management Studies*, 43(6), 1261-88.

Pallant, J., (2007). Survival manual: A step by step guide to data analysis using SPSS for windows, 3rd Edition, *Open University press*, McGraw-Hill, Uk.

For Peer Review

Rockart, J.F., (1979). Chief executives define their own data needs. *Harvard Business review*; 57(2): 81–93.

Saunders, M., Lewis P. and Thornhill, A. (2009). *Research Methods for Business Students*. Financial Times Prentice Hall Inc., London.

Schriesheim, C.A. (1979). The similarity of individual directed and group directed leader behavior descriptions. *Academy of Management Journal*, 22, 345–55.

Takim, R. (2009). The Management of Stakeholders' Needs and Expectations in the Development of Construction Projects in Malaysia, *Modern Applied Science*, vol. 3 No. 5 pp 167-175, www.ccsenet.org/journal.html, available 17/11/2010.

Winch, G. M., (2010). Managing Construction projects: an information processing approach, 2nd Edition, *Wiley-Blackwell*, West Sussex, UK.

Yang, J., *et al*. (2009). Exploring critical success factors for stakeholder management in construction projects, *Journal of Civil Engineering and Management*, 15: 4, 337-348.

Yang, R. J. (2014). An Investigation in Stakeholder Analysis in Urban Development Projects: Empirical or Rationalistic Perspectives, *International journal of Project Management*, 32(5), 838-849.

Yang, R. J. and Shen, G. Q. P., (2014). Framework for stakeholder management in construction projects, *Journal of Management in Engineering*, DOI: 10.1061/(ASCE)ME.1943-5479.0000285.

Formatted: Reference, Left, Indent: Left: 0", First line: 0"

List of Tables

For Peer Review

814 Table 4 Mean rating and ranking of Critical Success Factors for Stakeholder Management

815 Table 5 Result of GOF measures for both Conceptual and best fitting measurement models of

816 the CSFs for stakeholder management in construction

817 Table 6 Standardised path coefficients of observed variables' loading on latent variables

818 Table 7 Realigned critical success factors for stakeholder management in construction

819 projects

820 Table 8 Standardised correlation and covariance coefficients of the best fitting measurement

821 model of CSFs for stakeholder management in construction

822 Table 9 Standardised path coefficients of the conceptual structural model of the interrelations

823 among CSFs for stakeholder management in construction

824 Table 10 Result of GOF measures for both Conceptual and best fitting structural models

825 **Table 1 List of critical success factors (CSFs) for stakeholder management in**

826 **construction**

S/N	CSF	Source
1	Clearly formulating the project mission	Jerges *et al*., (2000); Akintoye *et al*. (2003) Thomson *et al*., (2003); Chinyio and Akintoye, (2008)
2	Ensuring the use of a favourable procurement method	Atkin and Skitmore, (2008); Olander and Landin, (2008); Rwelamila, (2010)
3	Carefully identifying and listing the project stakeholders	Mathur *et al*., (2008); Jepsen and Eskerod, (2009)
4	Ensuring flexible project organisation	Olander and Landin, (2008); Chinyio and Akintoye, (2008);
5	Identifying and understanding stakeholders' areas of interests in the project	Jepsen and Eskerod, (2009); Olander and Landin, (2008); Yang *et al*., (2009)
6	Determining and assessing the power (capacity to influence the actions of other stakeholders); urgency (degree to which stakeholders' claims requires immediate attention);	Mitchell *et al*., (1997); Yang *et al*., (2009)

For Peer Review

S/N	CSF	Source
	legitimacy (perceived validity of claims); and proximity (level of association or closeness with the project) of stakeholders	
7	Appropriately classifying stakeholders according to their attributes/characteristics	Karlsen, (2002); Mitchell *et al*., (1997)
8	Predicting and mapping stakeholders' behaviours (supportive, opposition, neutral etc)	Yang *et al*., (2009)
9	Predicting stakeholders' potential influence on each other	Pajunen, (2006); Jepsen and Eskerod, (2009)
10	Predicting stakeholders' potential influence on the project	Pajunen, (2006); Chinyio and Akintoye, (2008); Jepsen and Eskerod, (2009)
11	Identifying and analyzing possible conflicts and coalitions among stakeholders	Jepsen and Eskerod, (2009); Yang *et al*., (2009)
12	Resolving conflicts among stakeholders effectively	Yang *et al*., (2009)
13	Managing the change of stakeholders' interests	Jergeas *et al*., (2000); Jepsen and Eskerod, (2009)
14	Managing the change of stakeholders' influence	Jergeas *et al*., (2000); Olander (2006)
15	Managing the change of relationship among stakeholders	Pajunen, (2006); Chinyio and Akintoye, (2008)
16	Managing change of stakeholders' attributes	Olander (2006)
17	Managing how project decisions affect stakeholders	Chinyio and Akintoye, (2008)
18	Predicting stakeholders' likely reactions for implementing project decisions	Chinyio and Akintoye, (2008); Yang *et al*., (2009)
19	Involving relevant stakeholders to redefine (refine) project mission	Jerges *et al*., (2000); Yang *et al*., (2009)
20	Formulating appropriate strategies to manage/engage different stakeholders	Chinyio and Akintoye, (2008); Yang *et al*., (2009)
21	Keeping and promoting positive relationships among the stakeholders	Olander and Landin, (2008); Yang *et al*., (2009)
22	Communicating with stakeholders properly and frequently (instituting feedback mechanisms)	Jerges *et al*., (2000); Olander and Landin, (2008); Chinyio and Akintoye, (2008); Yang *et al*., (2009)
23	Considering corporate social responsibilities (paying attention to economic, legal, environmental and ethical issues)	Mathur *et al*., (2008); Yang *et al*., (2009)

For Peer Review

Table 2 Constructs and indicators of conceptual measurement model of CSFs for stakeholder management in construction

Constructs	Indicators
Stakeholder characteristics and project characteristics (SCPC)	• Clearly formulating the project mission; • Ensuring the use of a favourable procurement method; • Carefully identifying and listing the project stakeholders; • Ensuring flexible project organisation; • Identifying and understanding stakeholders' areas of interests in the project.
Stakeholder analysis (SA)	• Determining and assessing the power (capacity to influence the actions of other stakeholders); urgency (degree to which stakeholders' claims requires immediate attention); legitimacy (perceived validity of claims); and proximity (level of association or closeness with the project) of stakeholders; • Appropriately classifying stakeholders according to their attributes/characteristics; • Predicting and mapping stakeholders' behaviours (supportive, opposition, neutral etc); • Predicting stakeholders' potential influence on each other; • Predicting stakeholders' potential influence on the project; • Identifying and analyzing possible conflicts and coalitions among stakeholders;
Stakeholder dynamics (SD)	• Resolving conflicts among stakeholders effectively; • Managing the change of stakeholders' interests; • Managing the change of stakeholders' influence; • Managing the change of relationship among stakeholders; • Managing change of stakeholders' attributes; • Managing how project decisions affect stakeholders; • Predicting stakeholders' likely reactions for implementing project decisions.
Stakeholder engagement/empowerment (SE)	• Involving relevant stakeholders to redefine (refine) project mission; • Formulating appropriate strategies to manage/engage different stakeholders; • Keeping and promoting positive relationships among the stakeholders; • Communicating with stakeholders properly and frequently (instituting feedback mechanisms); • Considering corporate social responsibilities (paying attention to economic, legal, environmental and ethical issues).

For Peer Review

Table 3 Respondents' profiles

Professional Field	Years of Professional Experience: From 6 to 10 years	From 11 to 15 years	From 16 to 20 years	From 21 years and above	Total	%Total
Architecture	5	4	1	2	12	19.67
Construction Management	1	6	3	8	18	29.51
Quantity Surveying	3	3	3	5	14	22.95
Engineering	3	3	1	3	10	16.39
Facility Management	1	3	1	2	7	11.48
Total	13	19	9	20	61	100
%Total	21.31	31.15	14.75	32.79	100	

Table 4 Mean rating and ranking of Critical Success Factors for Stakeholder Management

Code	Critical Success factors for Stakeholder Management	Mean[a]	Rank
SE1	Involving relevant project stakeholders at the inception stage and whenever necessary to refine project mission	4.43	1
SCPC5	Identifying and understanding stakeholders' areas of interests in the project	4.33	2
SE4	Communicating with stakeholders properly and frequently	4.33	2
SD6	Managing how project decisions affect stakeholders	4.30	4
SD1	Resolving conflicts among stakeholders effectively	4.28	5
SE3	Keeping and promoting positive relationships among stakeholders	4.21	6
SCPC3	Carefully identifying and listing the project stakeholders from the on set	4.18	7
SCPC1	Clearly formulating the project mission	4.15	8
SCPC2	Ensuring the use of a favourable procurement route	4.13	9
SA6	Identifying and analysing possible conflicts and coalitions among stakeholders	4.11	10
SD7	Predicting stakeholders' likely reactions for implementing project decisions	4.07	11
SE2	Formulating appropriate strategies to manage/engage different stakeholders	4.07	11
SA5	Predicting stakeholders' potential influence on the project	4.03	13
SD3	Managing the change of stakeholders' influence	4.03	13
SA1	Determining and assessing the attributes (Power, Urgency, Legitimacy and proximity) of stakeholders in/to the project	4.03	15

Code	Critical Success factors for Stakeholder Management	Mean[a]	Rank
SE5	Considering corporate social responsibilities (paying attention to Economic, legal, environmental, and ethical issues)	4.03	15
SA2	Appropriately classifying stakeholders according to their attributes	4.03	15
SD4	Managing the change of relationship among stakeholders	4.02	18
SD2	Managing the change of stakeholders' interests	4.00	19
SA3	Predicting and mapping stakeholders' behaviours (Supportive, Opposition, Neutral, etc)	3.95	20
SA4	Predicting stakeholders' potential influence on each other	3.93	21
SD5	Managing change of stakeholders' attributes	3.92	22
SCPC4	Ensuring the use of flexible project organisation	3.85	23

Notes: [a]: 1= Strongly Disagree and 5= Strongly Agree.

For Peer Review

Table 5 Result of GOF measures for both Conceptual and best fitting measurement models of the CSFs for stakeholder management in construction

Goodness-of-fit (GOF) measures	Recommended level of GOF measures	Conceptual measurement model	Best fitting measurement model
CMIN/DF	1 (very good) – 2 (threshold)	1.41	1.18
Root mean sq. Error of approx. (RMSEA)	>0.05 (Very good) – 0.1 (threshold)	0.08	0.05
Root mean sq. Residual (RMR)	0 – 1 (Smaller values = better fit)	0.44	0.35
Goodness-of-fit index (GFI)	0 (no fit) – 1 (perfect fit)	0.72	0.82
Comparative-fit index (CFI)	0 (no fit) – 1 (perfect fit)	0.83	0.95
Incremental-fit index (IFI)	0 (no fit) – 1 (perfect fit)	0.84	0.95
Tucker-Lewis index (TLI)	0 (no fit) – 1 (perfect fit)	0.80	0.94

Table 6 Standardised path coefficients of observed variables' loading on latent variables

Latent variables and their indicators[a]	Standardised path coefficients
Stakeholder Characteristics and Project Characteristics (SCPC)[b]	
SCPC2	+0.54
SCPC3	+0.59
SA1	+0.55
SA2	+0.67
SE1	+0.65
Stakeholder Analysis (SA)[b]	
SA3	+0.68
SA4	+0.75
SA5	+0.70
SA6	+0.64
Stakeholder Dynamics (SD)[b]	

SD2	+0.78
SD3	+0.89
SD4	+0.75
SD6	+0.76
Stakeholder Engagement/Empowerment (SE)[b]	
SE2	+0.69
SE3	+0.72
SE5	+0.68

Note: The path coefficients are all statistically significant at level $P < 0.05$;
[a]: refer to Table 1 for full meanings of the indicators; [b]: Latent variables

Table 7 Realigned critical success factors for stakeholder management in construction projects

Realignment[a]	Critical Success Factors for Stakeholder Management	
	Final CSFs Code	Final SCFs
SE1 + SCPC1	SE1	Involving relevant project stakeholders at the inception stage and whenever necessary to formulate and refine project mission
SE3	SE3	None
SCPC3 + SCPC5	SCPC3	Carefully identifying and listing the project stakeholders and their areas of interests from the on set
SCPC2 + SCPC4	SCPC2	Ensuring the use of a favourable procurement route and flexible project organisation
SA6 + SD1	SA6	Identifying, analysing and resolving possible conflicts and coalitions among stakeholders
SE2 + SE4	SE2	Formulating appropriate communication strategies to manage/engage different stakeholders
SA5	SA5	None
SD3	SD3	None
SA1	SA1	None
SE5	SE5	None
SA2	SA2	None
SD4 + SD6	SD4	Managing the change of relationship among stakeholders and how project decisions affect them
SD2	SD2	None
SA3 + SD7	SA3	Predicting and mapping stakeholders' behaviours (Supportive, Opposition, Neutral, etc) and reactions for implementing project decisions
SA4	SA4	None
SD5	SD5	None

Note: [a:] affected CSFs are presented in bold in the first column

840 **Table 8 Standardised correlation and covariance coefficients of the best fitting**
841 **measurement model of CSFs for stakeholder management in construction**

Covariance links			Correlation Estimate	Covariance Estimate	S.E.	C.R.	Sig(P)
SCPC	<-->	SA	+0.773	0.147	0.049	2.980	0.003
SCPC	<-->	SD	+0.696	0.187	0.061	3.069	0.002
SCPC	<-->	SE	+0.768	0.135	0.046	2.963	0.003
SA	<-->	SD	+0.782	0.212	0.064	3.319	***
SA	<-->	SE	+0.730	0.130	0.044	2.963	0.003
SD	<-->	SE	+0.579	0.145	0.051	2.835	0.005

Formatted Table

842 *** Sig(P) value is infni9tesimally small (close to zero) hence cannot be reported

843 **Table 9 Standardised path coefficients of the conceptual structural model of the**
844 **interrelations among CSFs for stakeholder management in construction**

Hypothesised relationships			Path coefficient	S.E.	C.R.	Sig(P)	Interpretation
H1:PS	<---	SCPC	+0.012	0.389	0.040	0.968	Not supported
H2:SA	<---	SCPC	+0.772	0.244	3.165	0.002	Supported
H3:SD	<---	SCPC	+0.255	0.372	0.991	0.322	Not supported
H4:PS	<---	SA	-0.125	0.435	0.357	0.721	Not supported
H5:SE	<---	SA	+0.393	0.332	1.069	0.285	Not supported
H6:PS	<---	SD	+0.041	0.283	0.123	0.902	Not supported
H7:SD	<---	SA	+0.608	0.391	2.249	0.025	Supported
H8:SE	<---	SD	+0.634	0.117	3.507	***	Supported
H9:PS	<---	SE	+0.695	0.346	2.667	0.008	Supported
H10:SE	<---	SCPC	+0.528	0.324	1.503	0.133	Not supported

Formatted Table

*** Sig(P) value is infni9tesimally small (close to zero) hence cannot be reported

Formatted: Justified

845

846

For Peer Review

Table 10 Result of GOF measures for both Conceptual and best fitting structural models

Goodness-of-fit (GOF) measures	Recommended level of GOF measures	Conceptual structural model	Best fitting structural model
CMIN/DF	1 (very good) – 2 (threshold)	1.27	1.24
Root mean sq. Error of approx. (RMSEA)	>0.05 (Very good) – 0.1 (threshold)	0.07	0.06
Root mean sq. Residual (RMR)	0 – 1 (Smaller values = better fit)	0.05	0.04
Goodness-of-fit index (GFI)	0 (no fit) – 1 (perfect fit)	0.77	0.82
Comparative-fit index (CFI)	0 (no fit) – 1 (perfect fit)	0.90	0.92
Incremental-fit index (IFI)	0 (no fit) – 1 (perfect fit)	0.91	0.92
Tucker-Lewis index (TLI)	0 (no fit) – 1 (perfect fit)	0.89	0.90

List of Figures

For Peer Review

Figure 4 Final structural model of critical success factors for stakeholder management in construction

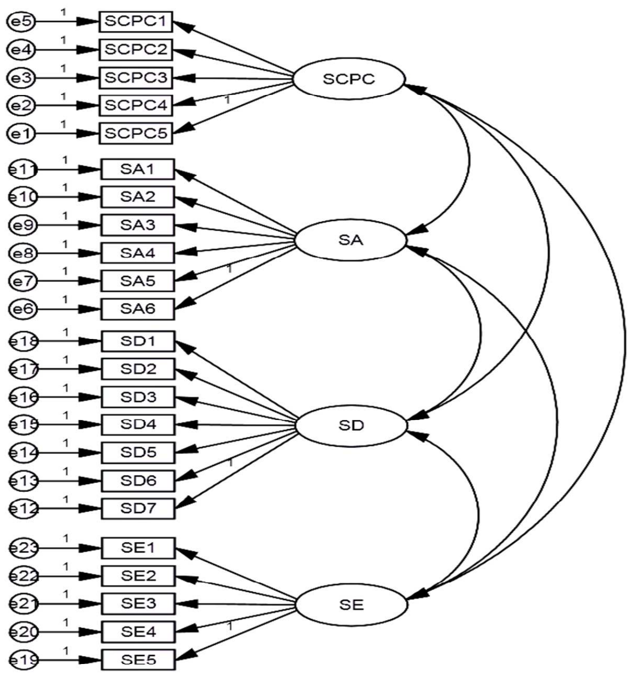


Figure 1 Conceptual Measurement Model of CSFs for Stakeholder Management in Construction

view

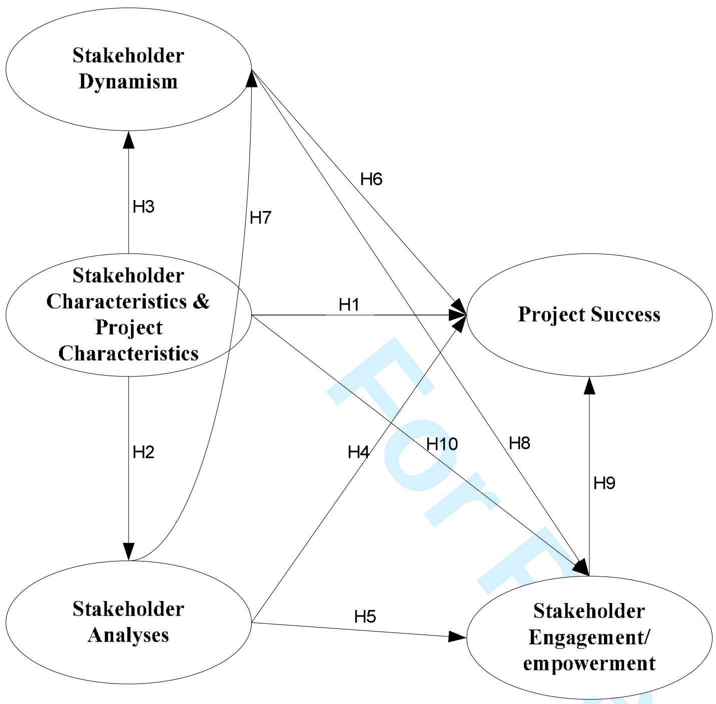


Figure 2 Hypothesised Structural Model of Critical Success Factors for Stakeholder Management in Construction

Formatted: Indent: Left: 0"

For Peer Review

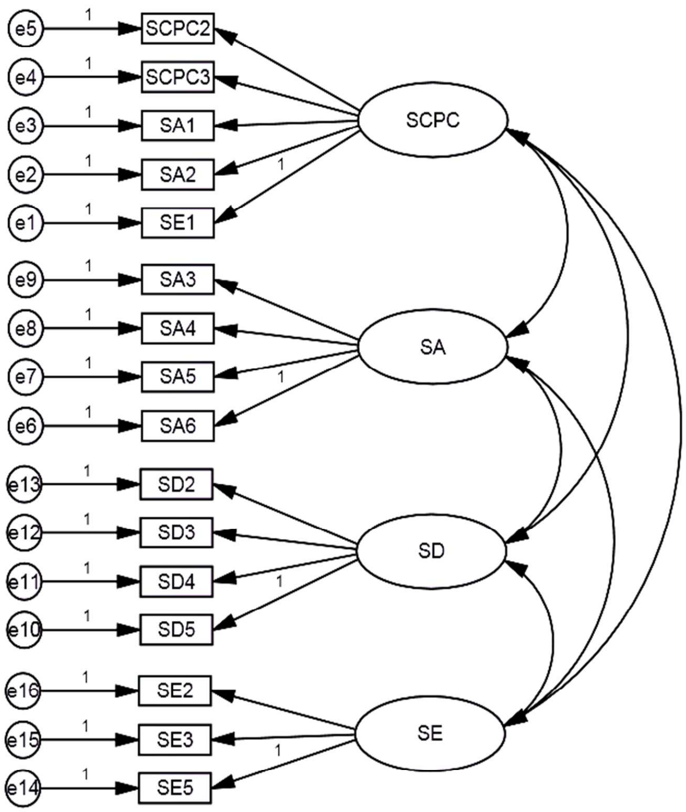
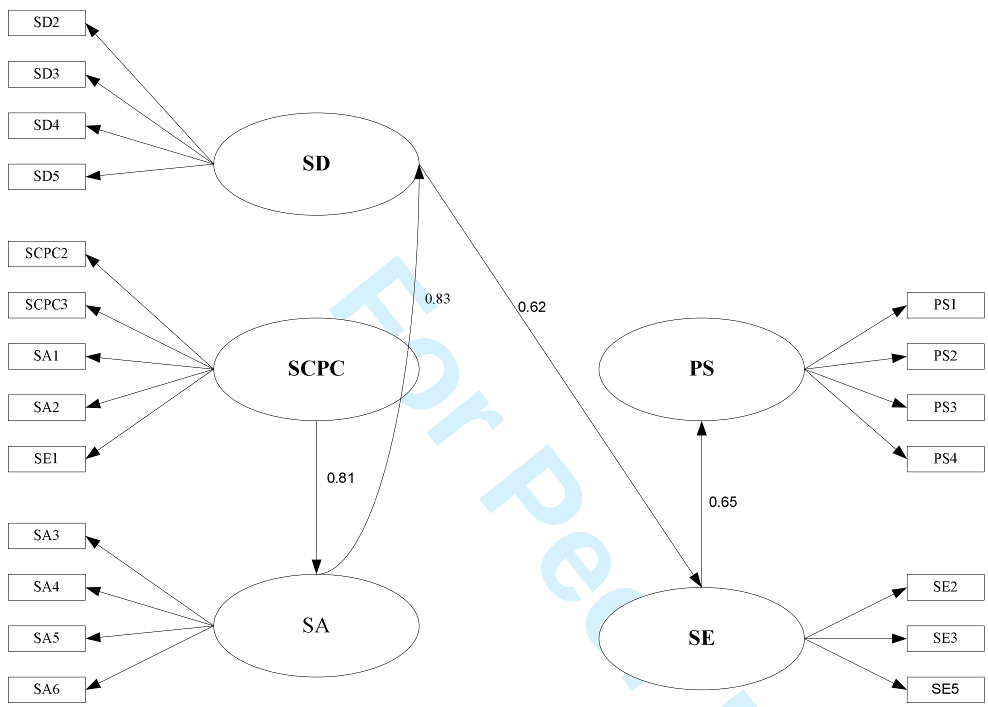


Figure 3 the Best Fit Measurement Model of CSFs for SM in Construction

867



868
869

870 **Figure 4 Final Structural Model of Critical Success Factors for Stakeholder**
871 **Management in Construction**

872 Appendix A: Un-rotated principal component analysis of critical success factors for stakeholder
873 management in construction projects.

Component Matrix[a]

Factor	Component					
	1	2	3	4	5	6
SCPC1	.351	.593	-.219	.525	-.307	.279
SCPC2	.385	-.032	-.459	.682	.457	.315
SCPC3	.488	.145	.684	-.082	.064	-.211
SCPC4	.131	-.454	.584	-.347	.368	.407
SCPC5	.536	.177	.552	.258	-.080	-.138
SA1	.427	-.097	-.267	.267	.417	-.510
SA2	.512	-.227	.174	.498	.233	-.160
SA3	.625	-.357	.223	-.060	.096	.094

For Peer Review

SA4	.677	-.219	.158	.205	-.011	.201
SA5	.645	-.121	.356	.271	-.217	-.060
SA6	.671	.088	-.136	.279	.017	.341
SD1	.479	.613	.265	-.219	-.086	.208
SD2	.742	-.045	-.138	-.027	-.338	.092
SD3	.756	-.246	-.316	-.096	-.348	.010
SD4	.689	-.460	-.118	-.167	-.053	-.107
SD5	.636	-.549	-.069	-.224	-.166	-.051
SD6	.724	.008	-.144	-.322	.175	-.221
SD7	.619	.136	-.136	-.375	-.028	-.227
SE1	.609	.181	-.154	.151	-.180	-.174
SE2	.638	.288	.164	-.580	.193	.014
SE3	.638	.417	.006	-.182	.295	.147
SE4	.510	.550	-.172	-.122	-.003	-.065
SE5	.662	.217	-.037	-.075	.092	.131

Extraction Method: Principal Component Analysis.

a. 6 components extracted.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.996	34.764	34.764	7.996	34.764	34.764
2	1.960	8.520	43.284	1.960	8.520	43.284
3	1.442	6.269	49.553	1.442	6.269	49.553
4	1.359	5.908	55.461	1.359	5.908	55.461
5	1.204	5.234	60.694	1.204	5.234	60.694
6	1.100	4.783	65.478	1.100	4.783	65.478
7	.998	4.339	69.817			
8	.926	4.027	73.844			
9	.782	3.398	77.242			
10	.773	3.362	80.604			
11	.670	2.912	83.516			
12	.607	2.641	86.157			
13	.507	2.204	88.361			
14	.497	2.161	90.521			
15	.402	1.748	92.270			
16	.376	1.634	93.904			
17	.352	1.529	95.433			
18	.294	1.279	96.712			
19	.225	.976	97.688			
20	.172	.748	98.436			
21	.138	.602	99.037			
22	.112	.487	99.524			
23	.109	.476	100.000			

Extraction Method: Principal Component Analysis.

For Peer Review